

# Silence Please

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### **CIT Semester 1 Examinations 2018/19**

<b>Note to Candidates:</b>	Check the <u>Programme Title</u> and the <u>Module Description</u> to ensure that you have received the correct examination. If in doubt please contact an Invigilator.
<b>Module Title:</b>	<b>Automotive Mathematics</b>
<b>Module Code:</b>	<b>MATH6001</b>
<b>Programme Title(s):</b>	BSc Auto Mgmt & Tech Y1
<b>Block Code(s):</b>	<b>TTMGT_7_Y1</b>
<b>External Examiner(s):</b>	<b>Dr. James Cruickshank</b>
<b>Internal Examiner(s):</b>	Dr. Mark Hartnett
<b>Instructions:</b>	Answer all four questions. All questions carry equal marks.
<b>Duration:</b>	2 Hours
<b>Required Items:</b>	

1. (a) Sean has a weekly wage of €1000. His standard cut-off point is €635 and his tax credit is €92 per week. The standard rate of income tax is 20% and the higher rate is 42%. Calculate the amount of income tax he pays each week. (4)
- (b) Given that the price of a car in Japan is 6,500,000 Japanese Yen (JPY) and the conversion rate is €1=129.57 JPY.
- i. Calculate the cost of this car in Euros. (3)
- ii. Calculate the cost you would have to pay to the Irish government given that they charge an extra 30% import duty on the cost of the car in Euros. (3)
- (c) Round the following number 1349.4556 to:
- i. 3 decimal places. (2)
- ii. 2 decimal places. (2)
- iii. 3 significant figures. (2)
- iv. 2 significant figures. (2)
- (d) The diameter of a tyre on a new Audi A5 was estimated to be 45 cm. When the tyre was measured correctly, the diameter was found to be 45.72 cm. Find the percentage error in the estimate and give your answer correct to one decimal place. (4)
- (e) An alloy of aluminium consists of aluminum, manganese and silicon in the ratio 22 : 3 : 1. If there are 12 kg of manganese in the alloy, find its total weight. (3)

2. (a) Find the monthly repayments on a four year car loan of €20,000 at an interest rate of 6% per annum. Give your answer correct to the nearest cent. (4)

(b) Given that the speed of light  $c$  is given as  $c = 299,792,458 \text{ ms}^{-1}$ . Express this value in scientific notation (standard form). (3)

(c) Three new cars and four new vans cost €192,500, while five new cars and six new vans cost €298,500.

i. How much does one new car cost? (2)

ii. How much does one new van cost? (2)

iii. How much do 60 new cars and 20 new vans cost? (3)

(d) The total energy  $E$  (in Joules) of a rollercoaster is given in terms of its kinetic energy  $KE = \frac{mv^2}{2}$  and its potential energy  $PE = mgh$ . The equation for the total energy  $E$  is written as:

$$E = \frac{mv^2}{2} + mgh$$

Given that the mass  $m$  of one passenger carriage is given as  $m = 350 \text{ kg}$ .

i. Calculate the potential energy  $PE$  (in Joules) of the passenger carriage if the acceleration due to gravity is  $g = 9.81 \text{ ms}^{-1}$  when the carriage is at a height  $h = 100 \text{ m}$ . (3)

ii. Transpose the formula  $E = \frac{mv^2}{2} + mgh$  to make  $m$  the subject. (4)

(e) Solve the following equation for  $t$ :

$$\frac{2t - 3}{4} = \frac{3t - 2}{5}$$

(4)

3. (a) A cylindrical tank for holding oil has radius 100 cm and a height of 300 cm.
- i. Find its capacity (volume) in cubic centimeters. (2)
  - ii. Find its capacity in litres. (2)
  - iii. How many gallons of oil can this tank hold, given that 1 litre = 0.22 gallons. (2)
- (b) i. Convert 4 radians to degrees. (3)
- ii. Convert 7 radians per second to revolutions per minute. (3)
- (c) The radius of a tyre is 14 inches. Given that one inch is 25.4 mm and the wheel does 500 rpm (revolutions per minute), calculate the speed of the vehicle in km per hour. (6)
- (d) The perimeter of an equilateral triangle is 720 cm.
- i. Calculate the length of each side. (2)
  - ii. Calculate the area of the triangle. (2)
  - iii. If one of the side of this triangle is halved and the other two sides remain the same length. How does this affect the area of the triangle? (3)

4. (a) The line  $L_3$  is given by the equation  $x - 2y = 3$ .

- i. Find the point,  $b$ , where  $L_3$  intersects the  $x - axis$ . (2)
- ii. Find the point,  $a$ , where  $L_3$  intersects the  $y - axis$ . (2)
- iii. Sketch a graph of the line  $L_3$  and find its slope. (5)
- iv. From your graph, determine the value of  $y$  which corresponds to  $x = 3$ . Verify your answer algebraically. (4)

(b) The velocity  $v$  (in metres per second) of a vehicle is measured at various times  $t$  and the results are recorded as follows:

Time $t$ (seconds)	20	40	60	80	100	120
Velocity $v$ (m/s)	42.2	47.4	53.2	56.7	58.4	63.7

- i. Draw, on graph paper, a graph of velocity against time and show that there is an approximate straight line relationship between velocity and time. (5)
- ii. Find the relationship between  $v$  and  $t$ . (5)
- iii. Hence find the value of  $v$  when  $t = 70$  s. (2)

## Formulae

### Percentage Error

$$\left| \frac{\text{Estimated} - \text{Actual}}{\text{Actual}} \right| \times 100$$

### Compound Interest

$$A = P(1 + i)^n$$

### Depreciation

$$A = P(1 - i)^n$$

### Monthly Repayments

$$A = P \left[ \frac{i(1 + i)^n}{(1 + i)^n - 1} \right]$$

Where  $A$  is the payment amount per period,  $P$  is the initial principal or loan amount,  $i$  is the interest rate as a decimal per compounding period and  $n$  is the total number of compounding periods.

### Volume of Cylinder

$$V = \pi R^2 h$$

### Capacity Conversion

$$1 \text{ litre} = 1000 \text{ cm}^3$$

### Capacity Conversion

$$1 \text{ kmhr}^{-1} = d \times \text{revolutions} \times 0.001885$$